

Patent Application of Markus D. Herrema for "Process for the  
Utilization of Ruminant Animal Methane Emissions" continued

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CLAIMS: I claim:

1. A method for producing methane-utilizing microorganisms in a confined apparatus comprising using the methane exhaled through ruminant animal exhalation as a source of carbon and/or energy for the growth of said microorganisms, comprising:
  - a. providing methane gas that has been exhaled through ruminant animal exhalation,
  - b. providing methane-utilizing microorganisms which can use said methane as a source of carbon and/or energy for growth,
  - c. providing a growth-culture medium which promotes the growth of said microorganisms, including a nutrient substrate and/or a microorganism immobilization means,
  - d. providing a means for the directed mutual-exposure of said methane, said microorganisms, and said growth-culture medium, including a means for the capture and conveyance of said methane and a means for confining said microorganisms, said growth-culture medium, and said methane to a specified apparatus existing outside of the digestive tract of a ruminant animal,

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- e. mutually-exposing said methane, said microorganisms, and said growth-culture medium to cause said microorganisms to grow in said apparatus using said methane and said growth-culture medium,

whereby said methane contained within said ruminant animal exhalation is utilized for the sustained growth of said microorganisms in a specified apparatus,

whereby said methane, an environmentally-destructive material and previously unusable source of energy, is used to produce a useful end-product, and

whereby said microorganisms can be harvested and utilized following growth, adding economic incentive to a ruminant animal methane emissions reduction effort.

- 2. The method of claim 1 wherein said conveyance means includes any means for conveying said methane within said ruminant animal exhalation to said mutual-exposure means.

- 3. The process of claim 2 wherein said conveyance means includes any means powered by solar, water, wind, ruminant animal activity, battery, stirling engine-type, electric, kinetic, manual, methane, methane-derived, density-differential, pressure-differential, and/or other functional source of power.

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4. The process of claim 2 wherein said conveyance means conveys said ruminant animal exhalation and said methane from the nostrils, mouth, or nostrils and mouth of a ruminant animal to said means of mutual-exposure.
5. The process of claim 1 wherein said mutual-exposure means comprises any means whereby said ruminant animal exhalation and said methane therein is conveyed and exposed to said methane-utilizing microorganisms and said growth-culture medium in a microorganism growth apparatus, whereby said methane-utilizing microorganisms reproduce in or on said growth-culture medium in said apparatus using said methane for growth.
6. The process of claim 5, including providing a means for causing said methane, said methane-utilizing microorganisms, and said growth/culture medium to be mutually-exposed in a batch, semi-batch, or continuous manner.
7. The process of claim 5, including providing a means for causing said microorganisms, said growth-culture medium, and said methane to be independently exposed in a batch, semi-batch, or continuous manner.

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8. The process of claim 1 wherein said growth-culture medium comprises any medium promoting the growth of said microorganisms, including any liquid, semi-liquid, gas, particulate, ceramic, foam, plastic, alginate gel, clay, nutrient, or other appropriate growth-culture medium.
9. The process of claim 8 wherein said growth-culture medium contains other microorganisms which promote the growth of said methane-utilizing microorganisms.
10. The process of claim 1 wherein said methane-utilizing microorganisms are either naturally-occurring or genetically-engineered.
11. The process of claim 10 wherein said microorganisms are either new or have been previously exposed in said mutual-exposure means.
12. The process of claim 1 wherein a determination of the type of said microorganisms to be used in said mutual-exposure and growth process is made in accordance with the environmental factors in which they are expected to grow, including factors such as temperature, density, methane-availability, and nutrient-availability.
13. The process of claim 1, including providing a means to periodically

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harvest the product of said microorganism growth, including microorganism biomass and any other products associated with said growth.

14. The process of claim 1, including providing a means to periodically replace and/or renew said growth-culture means.
15. The process of claim 1, including providing a means to situate said means of mutual-exposure entirely on the body of a ruminant animal.
16. The process of claim 1, including providing a means to situate said means of conveyance, but not entire said mutual-exposure means, on a ruminant animal.
17. The process of claim 1 wherein no part of said means of mutual-exposure is situated on a ruminant animal.